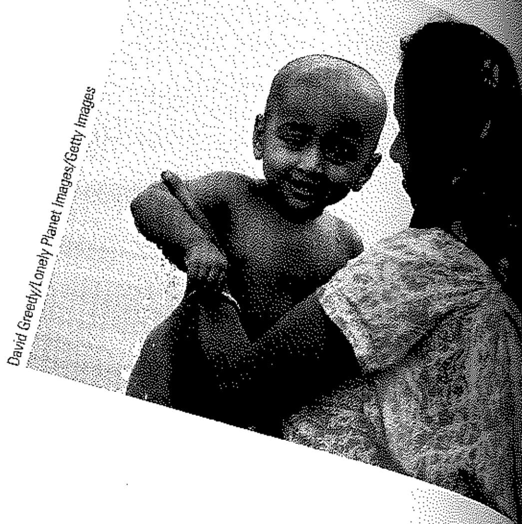
Module 45

Developmental Issues, Prenatal Development, and the Newborn



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Module Learning Objectives

45-1 Identify three issues that have engaged developmental psychologists.

45-2 Discuss the course of prenatal development, and explain how teratogens affect that development.

45-3 Describe some abilities of the newborn, noting how researchers are able to identify their mental abilities.

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developmental psychology a branch of psychology that studies physical, cognitive, and social change throughout the life span.

AP® Exam Tip

All three of these issues are important for development. Nature and nurture, of course, weaves its way through almost every module. It is one of the topics most likely to be on the AP® exam.

"Nature is all that a man brings with him into the world; nurture is every influence that affects him after his birth." -Francis Galton, *English Men of Science*, 1874

Developmental Psychology's Major Issues

45-1 What three issues have engaged developmental psychologists?

Developmental psychology examines our physical, cognitive, and social development across the life span, with a focus on three major issues:

1. *Nature and nurture:* How does our genetic inheritance (our *nature*) interact with our experiences (our *nurture*) to influence our development?
2. *Continuity and stages:* What parts of development are gradual and continuous, like riding an escalator? What parts change abruptly in separate stages, like climbing rungs on a ladder?
3. *Stability and change:* Which of our traits persist through life? How do we change as we age?

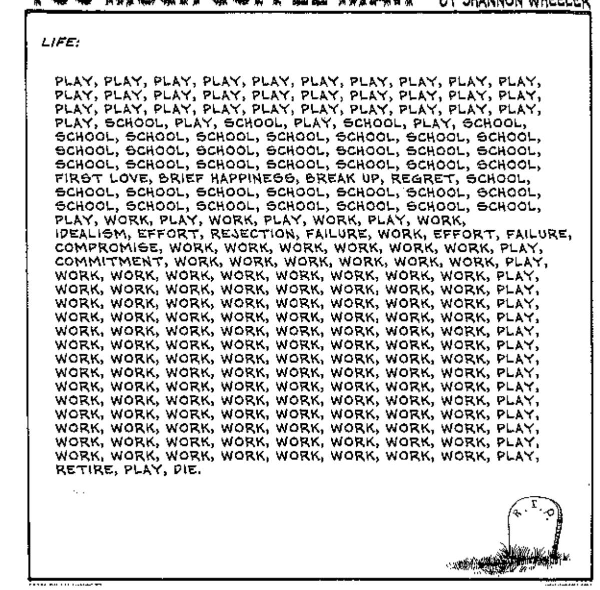
Let's reflect now on these three development issues.

Nature and Nurture

The gene combination created when our mother's egg engulfed our father's sperm helped form us, as individuals. Genes predispose both our shared humanity and our individual differences.

But it is also true that our experiences form us. In the womb, in our families, and in our peer social relationships, we learn ways of thinking and acting. Even differences initiated by our nature may be amplified by our nurture. We are not formed by either nature or nurture, but by their interrelationships—their *interaction*. Biological, psychological, and social-cultural forces interact.

Mindful of how others differ from us, however, we often fail to notice the similarities stemming from our shared biology. Regardless of our culture, we humans share the same life cycle. We speak to our infants in similar ways and respond similarly to their coos and cries (Bornstein et al., 1992a,b). All over the world, the children of warm and supportive parents feel better about themselves and are less hostile than are the children of punishing and rejecting parents (Rohner, 1986; Scott et al., 1991). Although ethnic groups differ in school achievement and delinquency, the differences are "no more than skin deep." To the extent that family structure, peer influences, and parental education predict behavior in one of these ethnic groups, they do so for the others as well. Compared with the person-to-person differences within groups, the differences between groups are small.



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Stages of the life cycle

Continuity and Stages

Do adults differ from infants as a giant redwood differs from its seedling—a difference created by gradual, cumulative growth? Or do they differ as a butterfly differs from a caterpillar—a difference of distinct stages?

Generally speaking, researchers who emphasize experience and learning see development as a slow, continuous shaping process. Those who emphasize biological maturation tend to see development as a sequence of genetically predisposed stages or steps: Although progress through the various stages may be quick or slow, everyone passes through the stages in the same order.

Are there clear-cut stages of psychological development, as there are physical stages such as walking before running? The stage theories of Jean Piaget on cognitive development, Lawrence Kohlberg on moral development, and Erik Erikson on psychosocial development propose that such stages do exist (as summarized in **FIGURE 45.1**). But some research casts doubt on the idea that life proceeds through neatly defined, age-linked stages. Young children have some abilities Piaget attributed to later stages. Kohlberg's work reflected a worldview characteristic of individualist cultures and emphasized thinking over acting. And adult life does not progress through a fixed, predictable series of steps. Chance events can influence us in ways we would never have predicted.

FYI

Another stage theory, Sigmund Freud's ideas about how personality develops, is discussed in Unit X.

Nevertheless, the concept of *stage* remains useful. The human brain does experience growth spurts during childhood and puberty that correspond roughly to Piaget's stages (Thatcher et al., 1987). And stage theories contribute a developmental perspective on the whole life span, by suggesting how people of one age think and act differently when they arrive at a later age.

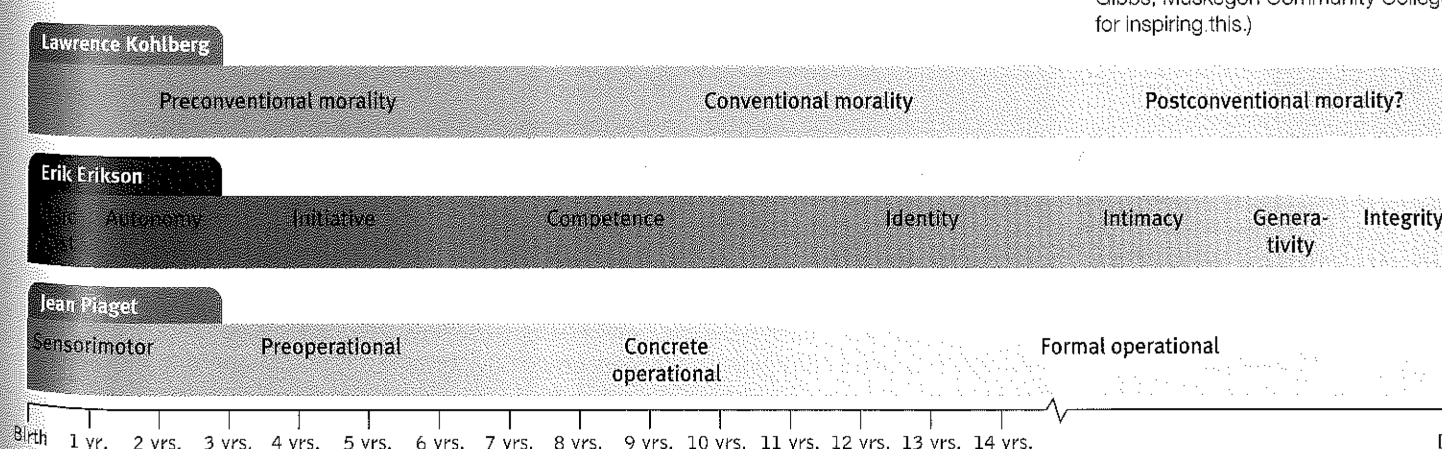


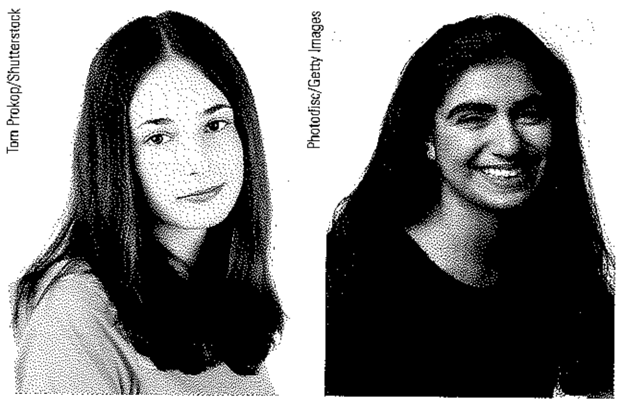
Figure 45.1
Comparing the stage theories (With thanks to Dr. Sandra Gibbs, Muskegon Community College, for inspiring this.)

Stability and Change

As we follow lives through time, do we find more evidence for stability or change? If reunited with a long-lost grade-school friend, do we instantly realize that "it's the same old Andy"? Or do people we befriend during one period of life seem like strangers at a later period? (At least one acquaintance of mine would choose the second option. He failed to recognize a former classmate at his 40-year college reunion. The aghast classmate pointed out that she was his long-ago first wife.)

Research reveals that we experience both stability and change. Some of our characteristics, such as *temperament* (our emotional reactivity and intensity), are very stable:

- One study followed 1000 3-year-old New Zealanders through time. It found that preschoolers who were low in conscientiousness and self-control were more vulnerable to ill health, substance abuse, arrest, and single parenthood by age 32 (Moffitt et al., 2011).
- Another study found that hyperactive, inattentive 5-year-olds required more teacher effort at age 12 (Houts et al., 2010).
- Another research team interviewed adults who, 40 years earlier, had their talkativeness, impulsiveness, and humility rated by their elementary school teachers (Nave et al., 2010). To a striking extent, the personalities persisted.



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Smiles predict marital stability In one study of 306 college alums, one in four with yearbook expressions like the one on the left later divorced, as did only 1 in 20 with smiles like the one on the right (Hertenstein et al., 2009).

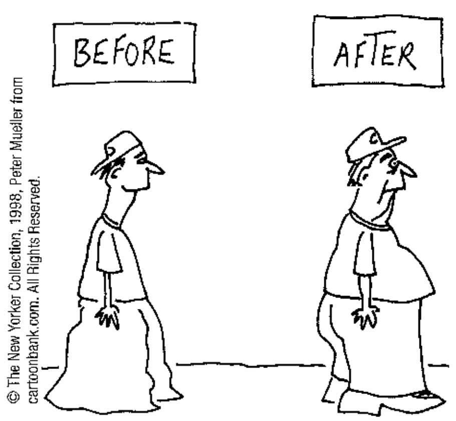
"At 70, I would say the advantage is that you take life more calmly. You know that 'this, too, shall pass'!" -Eleanor Roosevelt, 1954

"As at 7, so at 70," says a Jewish proverb. The widest smilers in childhood and college photos are, years later, the ones most likely to enjoy enduring marriages (Hertenstein et al., 2009). While one in four of the weakest college smilers eventually divorced, only 1 in 20 of the widest smilers did so. As people grow older, personality gradually stabilizes (Ferguson, 2010; Hopwood et al., 2011; Kandler et al., 2010). The struggles of the present may be laying a foundation for a happier tomorrow.

We cannot, however, predict all of our eventual traits based on our early years of life (Kagan et al., 1978, 1998). Some traits, such as social attitudes, are much less stable than temperament, especially during the impressionable late adolescent years (Krosnick & Alwin, 1989; Moss & Susman, 1980). Older children and adolescents learn new ways of coping. Although delinquent children have elevated rates of later work problems, substance abuse, and crime, many confused and troubled children blossom into mature, successful adults (Moffitt et al., 2002; Roberts et al., 2001; Thomas & Chess, 1986). Happily for them, life is a process of becoming.

In some ways, we *all* change with age. Most shy, fearful toddlers begin opening up by age 4, and most people become more conscientious, stable, agreeable, and self-confident in the years after adolescence (Lucas & Donnellan, 2009; Roberts et al., 2003, 2006, 2008; Shaw et al., 2010). Many irresponsible 16-year-olds have matured into 40-year-old business or cultural leaders. (If you are the former, you aren't done yet.) Such changes can occur without changing a person's position *relative to others* of the same age. The hard-driving young adult may mellow by later life, yet still be a relatively driven senior citizen.

Life requires *both* stability and change. Stability provides our identity. It enables us to depend on others and be concerned about the healthy development of the children in our lives. Our trust in our ability to change gives us our hope for a brighter future. It motivates our concerns about present influences and lets us adapt and grow with experience.



As adults grow older, there is continuity of self.

Before You Move On

▶ ASK YOURSELF

Are you the same person you were as a preschooler? As an 8-year-old? As a 12-year-old? How are you different? How are you the same?

▶ TEST YOURSELF

What findings in psychology support the concept of stages in development and the idea of stability in personality across the life span? What findings challenge these ideas?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

AP® Exam Tip

Almost every topic in psychology holds personal relevance, but development stands out. As you work your way through this unit, think of how the material relates to you, your relatives, and your friends. The more often you do this, the easier it will be to remember the material.

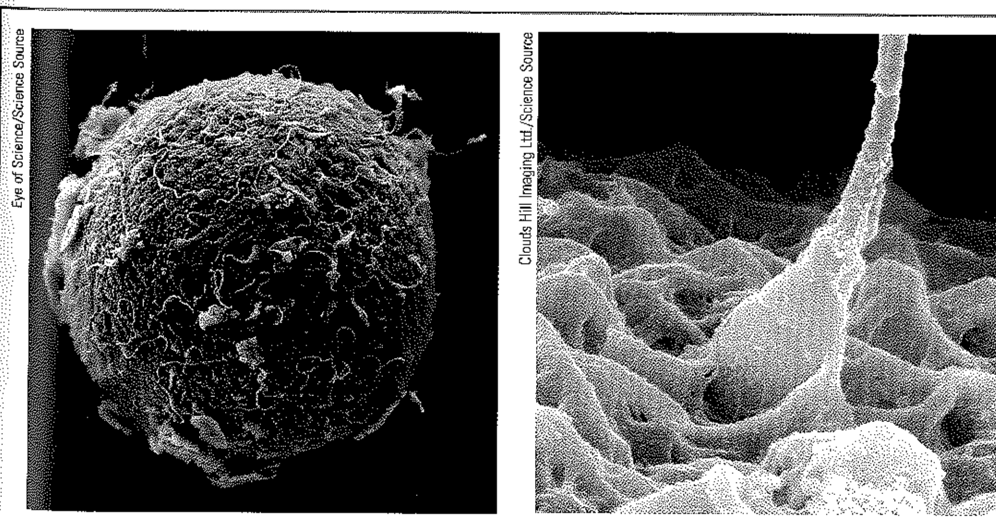
Prenatal Development and the Newborn

45-2 What is the course of prenatal development, and how do teratogens affect that development?

Conception

Nothing is more natural than a species reproducing itself. And nothing is more wondrous. With humans, the process starts when a woman's ovary releases a mature egg—a cell roughly the size of the period at the end of this sentence. The woman was born with all the immature eggs she would ever have, although only 1 in 5000 will ever mature and be released. A man, in contrast, begins producing sperm cells at puberty. For the rest of his life, 24 hours a day, he will be a nonstop sperm factory, with the rate of production—in the beginning more than 1000 sperm during the second it takes to read this phrase—slowing with age.

Like space voyagers approaching a huge planet, the 200 million or more deposited sperm begin their race upstream, approaching a cell 85,000 times their own size. The relatively few reaching the egg release digestive enzymes that eat away its protective coating (**FIGURE 45.2a**). As soon as one sperm penetrates that coating and is welcomed in (Figure 45.2b), the egg's surface blocks out the others. Before half a day elapses, the egg nucleus and the sperm nucleus fuse. The two have become one. Consider it your



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(a) (b)

Figure 45.2
Life is sexually transmitted (a) Sperm cells surround an egg. (b) As one sperm penetrates the egg's jellylike outer coating, a series of chemical events begins that will cause sperm and egg to fuse into a single cell. If all goes well, that cell will subdivide again and again to emerge 9 months later as a 100-trillion-cell human being.

most fortunate of moments. Among 200 million sperm, the one needed to make you, in combination with that one particular egg, won the race. And so it was for innumerable generations before us. If any one of our ancestors had been conceived with a different sperm or egg, or died before conceiving, or not chanced to meet the partner or . . . the mind boggles at the improbable, unbroken chain of events that produced you and me.

Prenatal Development

zygote the fertilized egg; it enters a 2-week period of rapid cell division and develops into an embryo.

embryo the developing human organism from about 2 weeks after fertilization through the second month.

fetus the developing human organism from 9 weeks after conception to birth.

Fewer than half of all fertilized eggs, called **zygotes,** survive beyond the first 2 weeks (Grobstein, 1979; Hall, 2004). But for you and me, good fortune prevailed. One cell became 2, then 4—each just like the first—until this cell division had produced some 100 identical cells within the first week. Then the cells began to differentiate—to specialize in structure and function. How identical cells do this—as if one decides "I'll become a brain, you become intestines!"—is a puzzle that scientists are just beginning to solve.

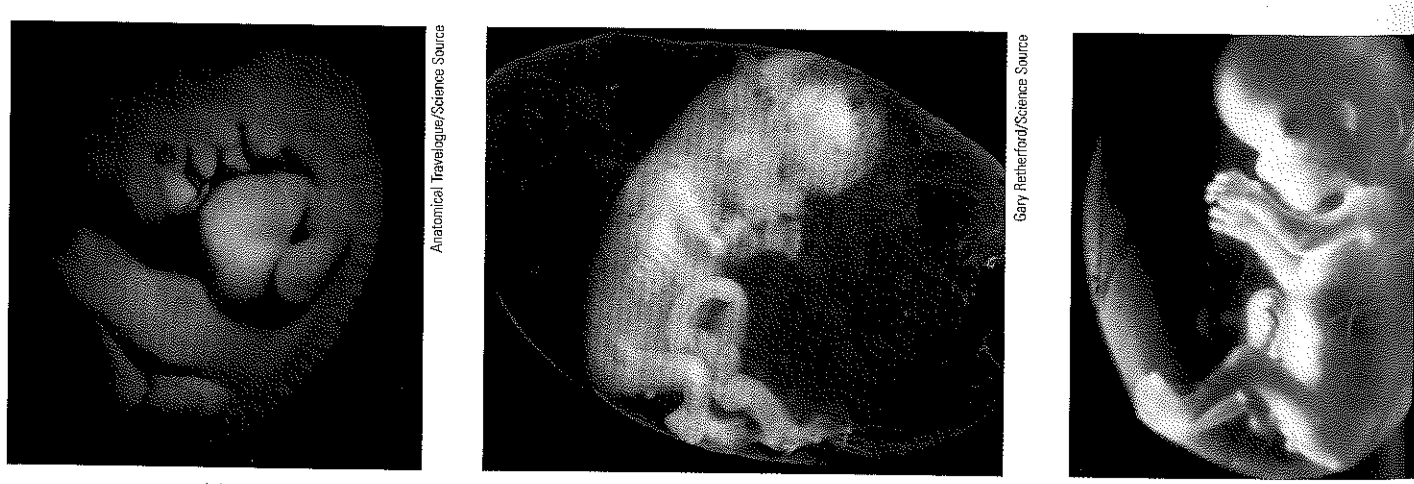
About 10 days after conception, the zygote attaches to the mother's uterine wall, beginning approximately 37 weeks of the closest human relationship. The zygote's inner cells become the **embryo** (**FIGURE 45.3a**). The outer cells become the *placenta,* the life-link that transfers nutrients and oxygen from mother to embryo. A healthy and well-nourished mother helps form a healthy baby-to-be. Over the next 6 weeks, the embryo's organs begin to form and function. The heart begins to beat.

For 1 in 270 sets of parents, though, there is a bonus. Two heartbeats will reveal that the zygote, during its early days of development, has split into two. If all goes well, two genetically identical babies will start life together some 8 months later (Module 14).

By 9 weeks after conception, an embryo looks unmistakably human (Figure 45.3b). It is now a **fetus** (Latin for "offspring" or "young one"). During the sixth month, organs such as the stomach have developed enough to give the fetus a good chance of survival if born prematurely.

At each prenatal stage, genetic and environmental factors affect our development. By the sixth month, microphone readings taken inside the uterus reveal that the fetus is responsive to sound and is exposed to the sound of its mother's muffled voice (Ecklund-Flores, 1992; Hepper, 2005). Immediately after birth, emerging from living 38 or so weeks underwater, newborns prefer her voice to another woman's or to their father's (Busnel et al., 1992; DeCasper et al., 1984, 1986, 1994). They also prefer hearing their mother's language. If she spoke two languages during pregnancy, they display interest in both (Byers-Heinlein et al., 2010). And just after birth, the melodic ups and downs of newborns' cries bear the tuneful signature of their mother's native tongue (Mampe et al., 2009). Babies born

Figure 45.3
Prenatal development (a) The embryo grows and develops rapidly. At 40 days, the spine is visible and the arms and legs are beginning to grow. (b) By the end of the second month, when the fetal period begins, facial features, hands, and feet have formed. (c) As the fetus enters the fourth month, its 3 ounces could fit in the palm of your hand.



to French-speaking mothers tend to cry with the rising intonation of French; babies born to German-speaking mothers cry with the falling tones of German. Would you have guessed? The learning of language begins in the womb.

In the 2 months before birth, fetuses demonstrate learning in other ways, as when they adapt to a vibrating, honking device placed on their mother's abdomen (Dirix et al., 2009). Like people who adapt to the sound of trains in their neighborhood, fetuses get used to the honking. Moreover, 4 weeks later, they recall the sound (as evidenced by their blasé response, compared with reactions of those not previously exposed).

Sounds are not the only stimuli fetuses are exposed to in the womb. In addition to transferring nutrients and oxygen from mother to fetus, the placenta screens out many harmful substances, but some slip by. **Teratogens,** agents such as viruses and drugs, can damage an embryo or fetus. This is one reason pregnant women are advised not to drink alcoholic beverages. A pregnant woman never drinks alone. As alcohol enters her bloodstream, and her fetus', it depresses activity in both their central nervous systems. Alcohol use during pregnancy may prime the woman's offspring to like alcohol and may put them at risk for heavy drinking and alcohol use disorder during their teens. In experiments, when pregnant rats drank alcohol, their young offspring later displayed a liking for alcohol's taste and odor (Youngentob et al., 2007, 2009).

Even light drinking or occasional binge drinking can affect the fetal brain (Braun, 1996; Ikonomidou et al., 2000; Sayal et al., 2009). Persistent heavy drinking puts the fetus at risk for birth defects and for future behavior problems, hyperactivity, and lower intelligence. For 1 in about 800 infants, the effects are visible as **fetal alcohol syndrome (FAS),** marked by lifelong physical and mental brain abnormalities (May & Gossage, 2001). The fetal damage may occur because alcohol has an *epigenetic effect:* It leaves chemical marks on DNA that switch genes abnormally on or off (Liu et al., 2009).

FYI
Prenatal development
zygote: conception to 2 weeks
embryo: 2 to 9 weeks
fetus: 9 weeks to birth

"You shall conceive and bear a son. So then drink no wine or strong drink." -Judges 13:7

teratogens (literally, "monster maker") agents, such as chemicals and viruses, that can reach the embryo or fetus during prenatal development and cause harm.

fetal alcohol syndrome (FAS) physical and cognitive abnormalities in children caused by a pregnant woman's heavy drinking. In severe cases, signs include a small, out-of-proportion head and abnormal facial features.

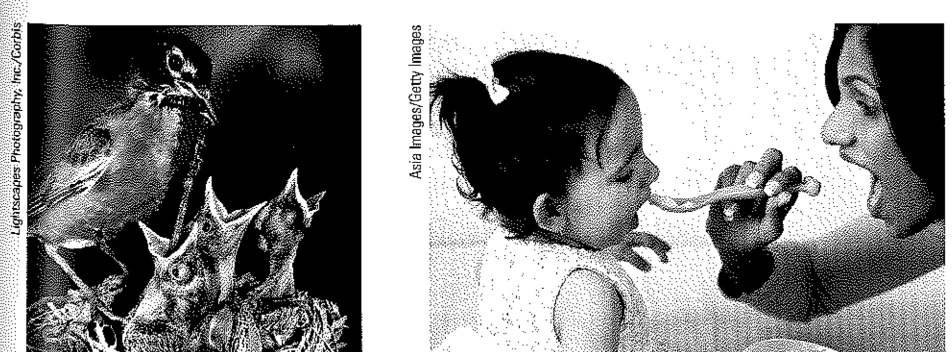
The Competent Newborn

45-3 What are some newborn abilities, and how do researchers explore infants' mental abilities?

Babies come with software preloaded on their neural hard drives. Having survived prenatal hazards, we as newborns came equipped with automatic reflex responses ideally suited for our survival. We withdrew our limbs to escape pain. If a cloth over our face interfered with our breathing, we turned our head from side to side and swiped at it.

New parents are often in awe of the coordinated sequence of reflexes by which their baby gets food. Thanks to the *rooting reflex,* when something touches their cheek, babies turn toward that touch, open their mouth, and vigorously root for a nipple. Finding one, they automatically close on it and begin *sucking*—which itself requires a coordinated sequence of reflexive *tonguing, swallowing,* and *breathing.* Failing to find satisfaction, the hungry baby may cry—a behavior parents find highly unpleasant and very rewarding to relieve.

"I felt like a man trapped in a woman's body. Then I was born." -Comedian Chris Bliss



Prepared to feed and eat Animals are predisposed to respond to their offsprings' cries for nourishment.

The pioneering American psychologist William James presumed that the newborn experiences a "blooming, buzzing confusion," an assumption few people challenged until the 1960s. But then scientists discovered that babies can tell you a lot—if you know how to ask. To ask, you must capitalize on what babies can do—gaze, suck, turn their heads. So, equipped with eye-tracking machines and pacifiers wired to electronic gear, researchers set out to answer parents' age-old questions: What can my baby see, hear, smell, and think?

habituation decreasing responsiveness with repeated stimulation. As infants gain familiarity with repeated exposure to a visual stimulus, their interest wanes and they look away sooner.

Consider how researchers exploit **habituation**—a decrease in responding with repeated stimulation. We saw this earlier when fetuses adapted to a vibrating, honking device placed on their mother's abdomen. The novel stimulus gets attention when first presented. With repetition, the response weakens. This seeming boredom with familiar stimuli gives us a way to ask infants what they see and remember.

An example: Researchers have used *visual preference* to "ask" 4-month-olds how they recognize cats and dogs (Quinn, 2002; Spencer et al., 1997). First, they showed the infants a series of images of either cats or dogs. Then they showed them hybrid cat-dog images (**FIGURE 45.4**). Which of those two animals do you think the infants would find more novel (measured in looking time) after seeing a series of cats? It was the hybrid animal with the dog's head (and vice versa if they previously viewed dogs). This suggests that infants, like adults, focus first on the face, not the body.

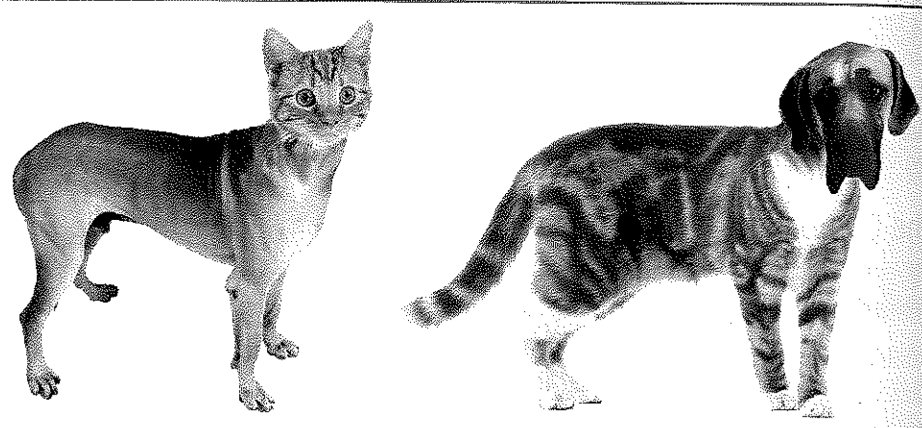


Figure 45.4
Quick—which is the cat? Researchers used cat-dog hybrid images such as these to test how infants categorize animals.

Indeed, even as newborns, we prefer sights and sounds that facilitate social responsiveness. We turn our heads in the direction of human voices. We gaze longer at a drawing of a face-like image (**FIGURE 45.5**). We prefer to look at objects 8 to 12 inches away. Wonder of wonders, that just happens to be the approximate distance between a nursing infant's eyes and its mother's (Maurer & Maurer, 1988).

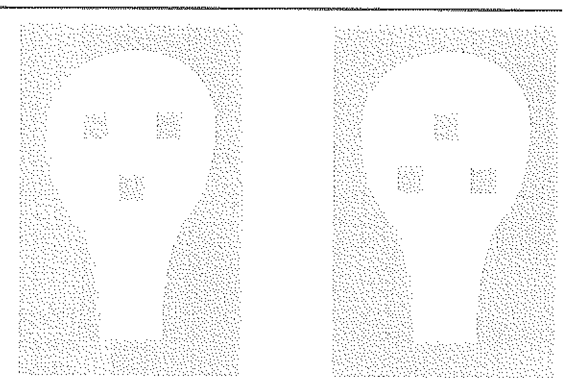


Figure 45.5
Newborns' preference for faces When shown these two stimuli with the same elements, Italian newborns spent nearly twice as many seconds looking at the face-like image (Johnson & Morton, 1991). Canadian newborns display the same apparently inborn preference to look toward faces (Mondloch et al., 1999).

Within days after birth, our brain's neural networks were stamped with the smell of our mother's body. Week-old nursing babies, placed between a gauze pad from their mother's bra and one from another nursing mother, have usually turned toward the smell of their own mother's pad (MacFarlane, 1978). What's more, that smell preference lasts. One experiment capitalized on the fact that some nursing mothers in a French maternity ward applied a balm with a chamomile scent to prevent nipple soreness (Delaunay-El Allam, et al., 2010). Twenty-one months later, their toddlers preferred playing with chamomile-scented toys! Their peers who had not sniffed the scent while breast feeding showed no such preference. (This makes one wonder: Will adults who as babies associated chamomile scent with their mother's breast become devoted chamomile tea drinkers?

Before You Move On

▶ ASK YOURSELF

Are you surprised by the news of infants' competencies? Remember hindsight bias from Module 4? Is this one of those cases where it feels like you "knew it all along"?

▶ TEST YOURSELF

Your friend's older sister—a regular drinker—hopes to become pregnant soon and has stopped drinking. Why is this a good idea? What negative effects might alcohol consumed during pregnancy have on a developing fetus?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 45 Review

45-1 What three issues have engaged developmental psychologists?

- *Developmental psychologists* study physical, mental, and social changes throughout the life span.
- They focus on three issues: nature and nurture (the interaction between our genetic inheritance and our experiences); continuity and stages (whether development is gradual and continuous or a series of relatively abrupt changes); and stability and change (whether our traits endure or change as we age).

45-2 What is the course of prenatal development, and how do teratogens affect that development?

- The life cycle begins at conception, when one sperm cell unites with an egg to form a *zygote*.
- The zygote's inner cells become the *embryo*, and in the next 6 weeks, body organs begin to form and function.
- By 9 weeks, the *fetus* is recognizably human.
- *Teratogens* are potentially harmful agents that can pass through the placental screen and harm the developing embryo or fetus, as happens with *fetal alcohol syndrome*.

45-3 What are some newborn abilities, and how do researchers explore infants' mental abilities?

- Babies are born with sensory equipment and reflexes that facilitate their survival and their social interactions with adults. For example, they quickly learn to discriminate their mother's smell and sound.
- Researchers use techniques that test *habituation*, such as the visual-preference procedure, to explore infants' abilities.

Multiple-Choice Questions

1. Alcohol is a teratogen that can slip through the ________ and damage the fetus or embryo.

a. placenta
b. nervous system
c. womb
d. brainstem
e. zygote

2. Even as newborns, we prefer sights and sounds that facilitate social responsiveness. This can be seen by a newborn's preference for

a. soft music.
b. face-like images.
c. low pitched sounds.
d. soft colors.
e. loud music.

3. As infants gain familiarity with repeated exposure to a visual stimulus, their interest wanes and they look away sooner. The decrease in an infant's responsiveness is called

a. concentration.
b. teratogens.
c. habituation.
d. stability.
e. transference.

4. Which question expresses the developmental issue of stability and change?

a. Are individuals more similar or different from each other?
b. How much of development occurs in distinct stages?
c. How much of development is determined by genetics?
d. To what extent do certain traits persist through the life span?
e. Which traits are most affected by life changes and experience?

5. What is the prenatal development sequence?

a. Zygote, embryo, fetus
b. Fetus, zygote, embryo
c. Embryo, zygote, fetus
d. Zygote, fetus, embryo
e. Fetus, embryo, zygote

6. Some people think development occurs much in the way a tree grows, slowly and steadily adding one ring each year. Others think that there are rather abrupt developmental jumps, like the transformation of a tadpole into a frog. Which of the following issues would this difference of opinion relate to?

a. Nature and nurture
b. Maturation and learning
c. Prenatal and neonatal
d. Stability and change
e. Continuity and stages

7. Which of the following is the longest prenatal stage?

a. Teratogen
b. Conception
c. Zygote
d. Embryo
e. Fetus

Practice FRQs

1. What is habituation? How is this phenomenon used by researchers in examining newborns' abilities?

Answer

1 point: Habituation is the decrease in responding with repeated stimulation.

1 point: Researchers use habituation to see what infants recognize and remember.

2. Three major issues are addressed by psychologists in the study of human development. Identify and state how all three might be considered to explain how children's traits and abilities develop.

(3 points)

Module 46

Infancy and Childhood: Physical Development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Module Learning Objectives

46-1 Describe some developmental changes in brain and motor abilities during infancy and childhood.

46-2 Describe how an infant's developing brain begins processing memories.

46-1 During infancy and childhood, how do the brain and motor skills develop?

During infancy, a baby grows from newborn to toddler, and during childhood from toddler to teenager. We all traveled this path, with its physical, cognitive, and social milestones.

As a flower unfolds in accord with its genetic instructions, so do we. **Maturation**—the orderly sequence of biological growth—decrees many of our commonalities. We stand before walking. We use nouns before adjectives. Severe deprivation or abuse can retard development. Yet the genetic growth tendencies are inborn. Maturation (nature) sets the basic course of development; experience (nurture) adjusts it. Once again, we see genes and scenes interacting.

"It is a rare privilege to watch the birth, growth, and first feeble struggles of a living human mind." -Annie Sullivan, in Helen Keller's *The Story of My Life*, 1903

maturation biological growth processes that enable orderly changes in behavior, relatively uninfluenced by experience.

Brain Development

In your mother's womb, your developing brain formed nerve cells at the explosive rate of nearly one-quarter million per minute. The developing brain cortex actually overproduces neurons, with the number peaking at 28 weeks and then subsiding to a stable 23 billion or so at birth (Rabinowicz et al., 1996, 1999; de Courten-Myers, 2002).

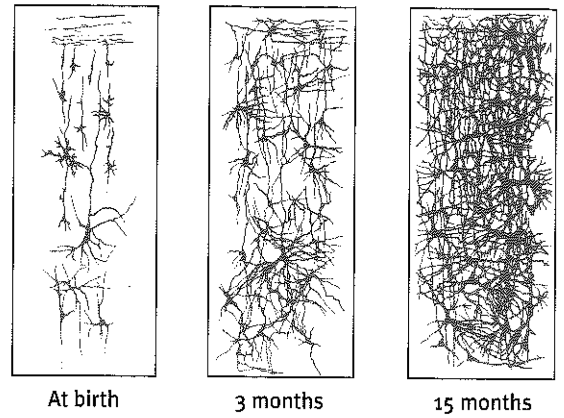
From infancy on, brain and mind—neural hardware and cognitive software—develop together. On the day you were born, you had most of the brain cells you would ever have. However, your nervous system was immature: After birth, the branching neural networks that eventually enabled you to walk, talk, and remember had a wild growth spurt (**FIGURE 46.1** on the next page). From ages 3 to 6, the most rapid growth was in your frontal lobes, which enable rational planning. This explains why preschoolers display a rapidly developing ability to control their attention and behavior (Garon et al., 2008).

The association areas—those linked with thinking, memory, and language—are the last cortical areas to develop. As they do, mental abilities surge (Chugani & Phelps, 1986; Thatcher et al., 1987). Fiber pathways supporting language and agility proliferate into puberty. A use-it-or-lose-it *pruning process* shuts down unused links and strengthens others (Paus et al., 1999; Thompson et al., 2000).

AP® Exam Tip

Note that maturation, to developmental psychologists, is a biological sequence. This is much more precise than the general notion that maturation means to become more adult-like.

Figure 46.1
Drawings of human cerebral cortex sections In humans, the brain is immature at birth. As the child matures, the neural networks grow increasingly more complex.



Motor Development

The developing brain enables physical coordination. As an infant's muscles and nervous system mature, skills emerge. With occasional exceptions, the motor development sequence is universal. Babies roll over before they sit unsupported, and they usually crawl on all fours before they walk (**FIGURE 46.2**). These behaviors reflect not imitation but a maturing nervous system; blind children, too, crawl before they walk.

There are, however, individual differences in timing. In the United States, for example, 25 percent of all babies walk by age 11 months, 50 percent within a week after their first birthday, and 90 percent by age 15 months (Frankenburg et al., 1992). The recommended infant *back-to-sleep position* (putting babies to sleep on their backs to reduce the risk of a smothering crib death) has been associated with somewhat later crawling but not with later walking (Davis et al., 1998; Lipsitt, 2003).

FYI

In the eight years following the 1994 launch of a U.S. Back to Sleep educational campaign, the number of infants sleeping on their stomach dropped from 70 to 11 percent—and SIDS (Sudden Infant Death Syndrome) deaths fell by half (Braiker, 2005).

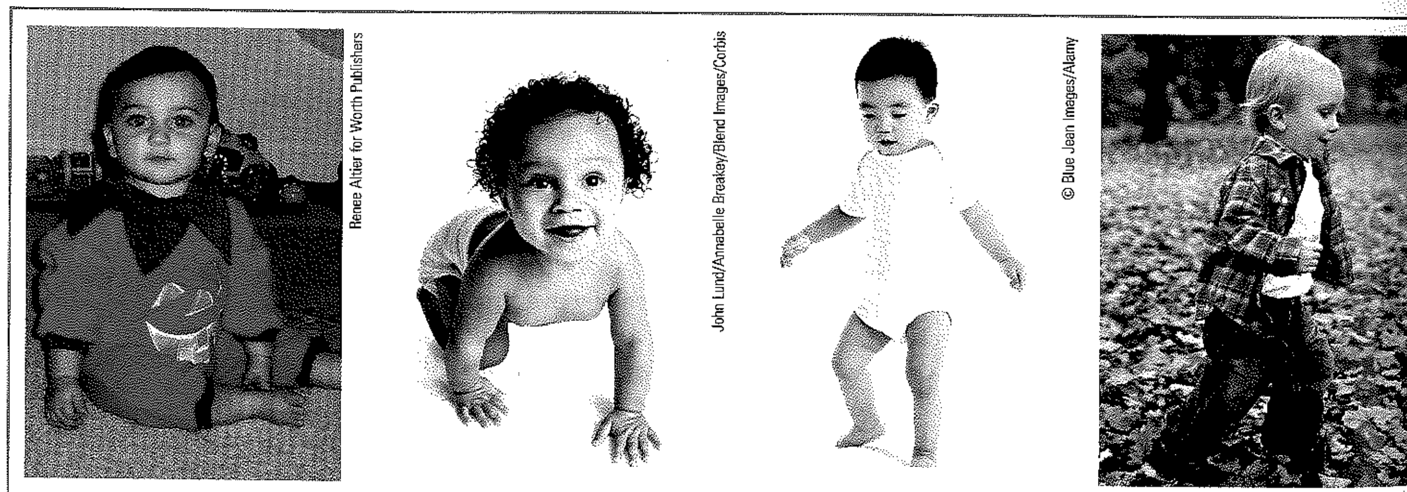


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Figure 46.2
Triumphant toddlers Sit, crawl, walk, run—the sequence of these motor development milestones is the same the world around, though babies reach them at varying ages.

Genes guide motor development. Identical twins typically begin walking on nearly the same day (Wilson, 1979). Maturation—including the rapid development of the cerebellum at the back of the brain—creates our readiness to learn walking at about age 1. Experience before that time has a limited effect. The same is true for other physical skills, including bowel and bladder control. Before necessary muscular and neural maturation, don't expect pleading or punishment to produce successful toilet training.

Brain Maturation and Infant Memory

46-2 How does an infant's developing brain begin processing memories?

"This is the path to adulthood. You're here."

Can you recall your first day of preschool or your third birthday party? Our earliest memories seldom predate our third birthday. We see this *infantile amnesia* in the memories of some preschoolers who experienced an emergency fire evacuation caused by a burning popcorn maker. Seven years later, they were able to recall the alarm and what caused it—*if* they were 4 to 5 years old at the time. Those experiencing the event as 3-year-olds could not remember the cause and usually misrecalled being already outside when the alarm sounded (Pillemer, 1995). Other studies confirm that the average age of earliest conscious memory is 3½ years (Bauer, 2002, 2007). As children mature, from 4 to 6 to 8 years, childhood amnesia is giving way, and they become increasingly capable of remembering experiences, even for a year or more (Bruce et al., 2000; Morris et al., 2010). The brain areas underlying memory, such as the hippocampus and frontal lobes, continue to mature into adolescence (Bauer, 2007).

Apart from constructed memories based on photos and family stories, we *consciously* recall little from before age 4. Yet our brain was processing and storing information during those early years. In 1965, while finishing her doctoral work in psychology, Carolyn Rovee-Collier observed a nonverbal infant memory. She was also a new mom, whose colicky 2-month-old, Benjamin, could be calmed by moving a crib mobile. Weary of hitting the mobile, she strung a cloth ribbon connecting the mobile to Benjamin's foot. Soon, he was kicking his foot to move the mobile. Thinking about her unintended home experiment, Rovee-Collier realized that, contrary to popular opinion in the 1960s, babies are capable of learning. To know for sure that her son wasn't just a whiz kid, she repeated the experiment with other infants (Rovee-Collier, 1989, 1999). Sure enough, they, too, soon kicked more when hitched to a mobile, both on the day of the experiment and the day after. They had learned the link between moving legs and moving mobiles. If, however, she hitched them to a different mobile the next day, the infants showed no learning, indicating that they remembered the original mobile and recognized the difference. Moreover, when tethered to the familiar mobile a month later, they remembered the association and again began kicking (**FIGURE 46.3**).

Traces of forgotten childhood languages may also persist. One study tested English-speaking British adults who had no conscious memory of the Hindi or Zulu they had spoken as children. Yet, up to age 40, they could relearn subtle sound contrasts in these languages that other people could *not* learn (Bowers et al., 2009). What the conscious mind does not know and cannot express in words, the nervous system somehow remembers.

Exactostock/SuperStock

Figure 46.3
Infant at work Babies only 3 months old can learn that kicking moves a mobile, and they can retain that learning for a month. (From Rovee-Collier, 1989, 1997.)

Before You Move On

▶ ASK YOURSELF

What do you tend to regard as your earliest memory? Now that you know about infantile amnesia, has your opinion changed about the accuracy of that memory?

▶ TEST YOURSELF

What is the biological growth process that explains why most children begin walking by about 12 to 15 months?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 46 Review

46-1 During infancy and childhood, how do the brain and motor skills develop?

- The brain's nerve cells are sculpted by heredity and experience. Their interconnections multiply rapidly after birth, a process that continues until puberty, when a pruning process begins shutting down unused connections.
- Complex motor skills—sitting, standing, walking—develop in a predictable sequence, though the timing of that sequence is a function of individual *maturation* and culture.

46-2 How does an infant's developing brain begin processing memories?

- We have no conscious memories of events occurring before about age 3½, in part because major brain areas have not yet matured.

Multiple-Choice Questions

1. As the infant's brain develops, some neural pathways will decay if not used. This use-it-or-lose-it process is known as

a. motor development.
b. pruning.
c. spacing.
d. accommodation.
e. maturation.

2. Which of the following depends least on the maturation process?

a. Riding a bike
b. Writing
c. Talking
d. Bladder control
e. Telling time

3. Which of the following is true of the early formation of brain cells?

a. They form at a constant rate throughout the prenatal period.
b. They begin forming slowly, and then the rate increases throughout prenatal development.
c. They form slowly during the prenatal period, and then the rate increases after birth.
d. They form at a constantly increasing rate prenatally and in early childhood.
e. They are overproduced early in the prenatal period, and then the rate decreases and stabilizes.

4. Neural networks grow more complex by

a. branching outward to form multiple connections.
b. keeping the nervous system immature.
c. controlling one another with a restricted response system.
d. limiting connections.
e. associating behaviors that would not normally be associated together.

Practice FRQs

1. Define and give an example of maturation. Define infantile amnesia and explain how maturation contributes to this phenomenon.

Answer

1 point: Maturation is the orderly changes in behavior that result from biological processes that are relatively unaffected by experience.

1 point: Various examples will serve here, such as the normal development of motor skills (e.g., rolling over, crawling) or bladder and bowel control.

1 point: Infantile amnesia is our inability to remember events that occurred before we are about 3½ years old.

1 point: The brain areas underlying memory need to mature before we can remember accurately. This maturation doesn't happen until after the age of 3.

2. Three types of development are listed below. Give a specific example of each.

- Brain development
- Motor development
- Infant memory

(3 points)